

## Calculations Involving Molar Mass

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Molar mass is used as a conversion factor to switch between the number of moles of a substance and the mass of a substance.

To do these calculation, and many others we will see later, we use a technique called the factor-label method. In this technique we identify a key value that is given in the question and use one

or more factors to convert the value into the one asked for in the question. The units, or labels, will determine how to do the conversion. As an example of this, suppose you want to convert 250 mL into litres:

$$1000 \text{ mL} = 1 \text{ L}$$

$\therefore \frac{1000 \text{ mL}}{1 \text{ L}}, \frac{1 \text{ L}}{1000 \text{ mL}}$ 
note there are two conversion factor

$\text{key value} \rightarrow 250 \text{ mL} \times \frac{\text{conversion factor } 1 \text{ L}}{1000 \text{ mL}} = 0.25 \text{ L}$

Notice that units on the conversion factor

cancel the units on the key value and give us the units for the quantity being sought.

This technique is used to convert moles of a substance into grams and grams of substance into moles.

Example #1 : How many grams of water are there in 2.0 moles of water ?

$$M_{H_2O} = 2 \times M_H + M_O = 2(1.01 \text{ g/mol}) + 16.00 \text{ g/mol} = 18.02 \text{ g/mol}$$

$$\frac{18.02 \text{ g}}{1 \text{ mol}}, \frac{1 \text{ mol}}{18.02 \text{ g}}$$

$$m_{H_2O} = 2.0 \text{ mol} \times \frac{18.02 \text{ g}}{1 \text{ mol}} = 36.04 \text{ g}$$

$\therefore$  there are 36.04 g of water

Example #2: How many moles of sodium hydroxide are present in 20.0 g of NaOH.

$$\begin{aligned} M_{NaOH} &= M_{Na} + M_O + M_H = 22.99 \text{ g/mol} + 16.00 \text{ g/mol} + 1.01 \text{ g/mol} \\ &= 40.00 \text{ g/mol} \end{aligned}$$

$$\frac{40.00 \text{ g}}{1 \text{ mol}}, \quad \frac{1 \text{ mol}}{40.00 \text{ g}}$$

$$n = 20.0 \text{ g} \times \frac{1 \text{ mol}}{40.00 \text{ g}} = 0.50 \text{ mol} \quad \cancel{\frac{\text{g}^2}{\text{mol}}}$$

use  $n$   
to represent  
# of moles

$\therefore$  there are 0.50 mol of NaOH  
in 20.0 g.

See textbook p105 for a summary of  
the factor-label method and p468 for a full  
explanation.

Homework

$\left\{ \begin{array}{ll} \text{p 94} & \text{P1,2} \\ \text{p 95} & \text{P3,4,5} \end{array} \right.$

p100 P12,13

p102 P14,15